



**Evidence for
Excellence in
Education**

Report

Audit of the Bloodhound Education Programme, 2012-2013

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Acknowledgements

The National Foundation for Educational Research (NFER) is grateful to all those who have contributed to this study. We would like to thank the Bloodhound Education Programme for commissioning this research, in particular Jonathan Ellis for his valuable feedback.

Thanks are due to Emily Lamont at NFER for her guidance; to Fiona Walker for her quality assurance role; and to Neelam Basi for her administrative support throughout the project.

The project team was directed by Suzanne Straw and led by Jennifer Jeffes.

Published in January 2015
by the National Foundation for Educational Research,
The Mere, Upton Park, Slough, Berkshire SL1 2DQ
www.nfer.ac.uk

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Registered Charity No. 313392

ISBN 978-1-908666-64-2

How to cite this publication:

Jeffes, J., Straw, S., Dawson, A. and Lord, P. (2015). *Audit of the Bloodhound Education Programme, 2012-2013*. Slough: NFER.

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Executive summary

1. Background and introduction

The National Foundation for Educational Research (NFER) has been commissioned by the Bloodhound Education Programme (BEP) to conduct an audit of its activities throughout 2012 and early 2013, building on the findings of two previous audits in late 2009 and early 2012.

1.1 The Bloodhound Engineering Project

The aim of the Bloodhound Engineering Project is to design and build a Super Sonic Car (SSC) that will break the world land speed record, which is currently set at 763 mph. The car is now in its build phase and in 2015 it will be shipped to South Africa, aiming for a new world record of 1,000 mph/Mach 1.4.

1.2 The Bloodhound Education Programme

The BEP was launched in 2008 and uses Bloodhound SSC as an inspiring context with which to attract young people to careers in science, technology, engineering and mathematics (STEM).

The key activities conducted by the BEP include: development and provision of free educational resources and materials; events, roadshows and school visits; informal education; and engagement with private and public sector partners.

2. Management, staffing and funding

2.1 Management and staffing

The BEP is managed and delivered by a core team of staff supported by a network of volunteers, known as Bloodhound Ambassadors. The size of the core team has grown considerably throughout 2012.

2.2 Funding

The BEP's outreach work is self-funding, using income derived from its events and roadshows. In 2012, the BEP was allocated £120,000 of a grant awarded to the Bloodhound Engineering Project by the Engineering and Physical Sciences Research Council (EPSRC). This funding has been used to develop resources throughout all key stages, including higher and further education.

The total expenditure of the education project to date (from April 2007 to June 2013) is £1.48 million.

3. Progress since the 2012 audit

3.1 Overview of progress since early 2012

The Bloodhound SSC has been subject to increasing interest over the past year. This has increased demand for educational activities offered by the BEP. As a result, the BEP has



had to prioritise its activities in order to manage its time and resources effectively. The BEP has focused on those activities leading to a lasting impact.

3.2 Bloodhound Ambassadors

A total of 525 Bloodhound Ambassadors currently volunteer with the BEP. Of these, 46 per cent are independent Ambassadors and 54 per cent are Ambassadors from businesses which have made a corporate commitment to the BEP. There are also 5,815 members of the Bloodhound SSC supporters' club, the 1K Club.

The BEP provides free introductory training for its Bloodhound Ambassadors. Ambassadors can also access training offered by STEMNET. Ambassadors are supported by a dedicated Bloodhound Ambassador Programme Manager. In 2013, the BEP held its first two Ambassador conferences and more are planned for the future.

3.3 School visits, roadshows and events

The BEP and Bloodhound Ambassadors supported or led 133 separate educational events in the UK throughout 2012, representing a total of 284 days spent at events. The BEP estimates that 56,800 pupils were involved in Bloodhound educational activities in 2012 (based on an average of 200 pupils per day). This includes national and regional events, and locally organised events and school visits.

Over the past year, the BEP has embedded its schools workshops programme, which aims to engage with both local authorities and schools as part of a county-wide offer. To date, the BEP has held six county-wide events and discussions are underway to deliver events in a further six counties.

3.4 Online engagement

The BEP team has made considerable progress in developing its online offer for teachers, pupils and schools over the past year. This includes:

Bloodhound BLAST: Launched in March 2013, Bloodhound BLAST is a free, interactive learning environment relating to the Bloodhound project. Users are encouraged to join communities of common interest and to contribute new materials. The site is intended to have global reach, including schools, engineers and Ambassadors from all over the world. The BEP aims for Bloodhound BLAST to become a 'one-stop-shop' for STEM activities. To date, Bloodhound BLAST has been used by 188 Bloodhound Ambassadors and 133 teachers.

Web registrations: To date, a total of 5,453 educational institutions have registered with the BEP. Of these, 28 per cent have registered directly through the website and the remainder through Bloodhound's partner programmes and events. Primary schools make up more than half of all registrations, and the majority are mixed intake, state schools. Registrations have continued to increase throughout the life of the project.

Social media: The BEP has continued to increase its social media presence, including Facebook, Twitter and YouTube.

3.5 Resources

Over the past year, the BEP has taken an increasingly systematic approach to developing resources, using both internally produced and externally commissioned materials. The BEP



aims to ensure that all resources link closely to the curriculum, with educational outcomes a key priority.

Current resources for schools: To date, the BEP has produced almost 40 resources from Key Stage 1 to 5, all of which are hosted on Bloodhound BLAST. Many are also available to download from the TES website, the National STEM Centre eLibrary and STEMNET's website.

Bloodhound@University: The University of the West of England (UWE), in collaboration with the University of Southampton, continues to develop the Bloodhound@University 'K Box' – an online portal holding raw data from the Bloodhound Engineering Project.

Bloodhound@University currently has 70 academic subscribers and 150-200 resources. To date, there have been 6,500 downloads. Bloodhound@University is awarding seedcorn funding to academics who will add content and interact with the data. The aim of this is to increase usage, functionality and impact of the resources.

Externally commissioned resources: The BEP has commissioned a number of external organisations to produce high quality STEM teaching resources for use across all key stages. A Key Stage 5 work package will be ready for use in schools in September 2013. A series of careers themed lessons for Key Stage 2 and 3 pupils will later be introduced.

3.6 Partnerships

Partnerships are an important element of the BEP's operations and activities. However, progress in this area has been limited this year as the BEP has instead focused on meeting demand in schools and improving the development of resources.

The BEP has maintained its existing links with a range of private sector partners and educational partners with similar or complementary aims. The BEP has identified partnerships as a key priority for future development.

4. What is working well?

Participants in the audit identify a number of particularly successful ways in which the BEP operates and areas of good practice. This includes:

4.1 Creativity and innovation

The BEP continues to develop creative and innovative ways to promote their learning materials and increase the engagement of schools. For example, Bloodhound BLAST is considered to have tremendous potential to increase access to a range of new, interactive resources.

4.2 Systematic development and use of resources

The BEP has invested considerable time and resources into the development of materials for schools. The development of resources is now more systematic and recent resources contain a greater number of curriculum links.

Feedback from teachers suggest that the BEP's materials for schools are of high quality, and some schools have been able to provide examples of ways in which these resources have been successfully embedded into the curriculum.



Teachers also report positive feedback about the resources and materials delivered at BEP events and workshops.

4.3 Engagement with, and work of, Ambassadors

The commitment, enthusiasm and calibre of the BEP's network of Bloodhound Ambassadors is a key strength of the project. Flexibility in the ways that Ambassadors can engage with the BEP is critical to its success.

The BEP has put in place a number of measures to increase the levels of support for Ambassadors. This includes regular newsletters and a 'buddying' system for less experienced Ambassadors.

5. Outcomes to date

A variety of outcomes have been realised for a range of beneficiaries of the BEP.

5.1 Outcomes for young people

Enthusiasm and inspiration: Young people gain a sense of 'fun' from the Bloodhound activities they take part in, as well as for some, deeper inspiration and interest in relation to engineering.

Understanding, knowledge and skills: Increased awareness and appreciation of engineering and STEM is a strong outcome from the BEP. Making links to real life is considered important, and for some young people there is an increased understanding of the importance of engineering and STEM to technological advances.

New learning about engineering: Young people gain specific knowledge, understanding and skills in engineering and STEM. Practical activities are important in realising these impacts. Relating it to 'real life' is also important to enhancing young people's understanding.

Other new learning: Young people develop wider skills such as team work, problem solving, self-confidence and communication skills as a result of involvement with Bloodhound.

For some schools the BEP provides an excellent opportunity to work in a cluster with other schools and, as a result, to improve transitions between primary and secondary school for their young people.

Interest in engineering careers: Inspiring young people to think about engineering careers is felt to be a vital part of the BEP. Some teachers feel that talks about careers with engineering are most helpful for Key Stage 4 pupils. However, for sustainability, many feel that 'starting young' is important:

5.2 Outcomes for teachers

Outcomes for teachers include new and wider subject knowledge and teachers gaining tips for STEM activities they can run themselves.

Where schools are working in clusters on the Bloodhound challenge, impacts include greater school-school collaboration, new projects being introduced into other schools, and the development of work for specific groups of young people.



5.3 Outcomes for Bloodhound Ambassadors

Outcomes for Bloodhound Ambassadors include: personal satisfaction and enjoyment; development of skills and confidence in engaging with young people, including skills in presenting to large groups; enhancement of their own skills and knowledge relating to STEM; and CV building.

In addition, Ambassadors report feeling a sense of membership of the Bloodhound team, and feeling part of a network. Furthermore, some report wanting to 'spread the word' amongst workplace colleagues.

5.4 Outcomes for businesses

Outcomes for businesses include increased corporate commitment to raising young people's/public's interest in STEM and engineering, as well as the reputational benefits of working with the BEP.

This year, interviewees have particularly told us about consolidating their links with their local communities, FE colleges and schools.

5.5 Sustainability

Participants report that the extent to which the overwhelming impacts of enthusiasm and inspiration amongst young people then translate into longer term motivation for, or further engagement in, engineering activities is difficult to ascertain. Many of the activities that the BEP is already undertaking (for example, developing resources with greater curriculum links) are considered to be beneficial in promoting longer-term outcomes.

Amongst businesses and partners, there is great enthusiasm to maintain links with the BEP and to train more Ambassadors. The BEP therefore has a tremendous opportunity to build and foster relationships with both new and existing partners.

6. Areas for development

The BEP has made strong progress over the past year. As a continually evolving organisation, there are some areas which may benefit from further development to improve and enhance the BEP's education offer.

6.1 Expanding the range of activities available to schools

While the activities currently offered by the BEP team are popular with schools, it may be useful for the BEP to consider expanding the range of activities and resources offered to encompass new topic areas and themes. This would be particularly valuable for schools with an interest in engaging repeatedly with Bloodhound activities, or in using resources on an ongoing basis in school.

Teachers have mixed views about the extent to which the activities offered by the BEP meet the needs of different age groups. This suggests that it may be beneficial for the BEP to consider how existing resources can be more easily adapted to suit the needs of different age groups and abilities.

6.2 Data monitoring and evaluation

The BEP team, Bloodhound Ambassadors and partners identified data collection relating to the impacts of Bloodhound activities as a key priority for development. While there are



mechanisms currently in place to collect monitoring and evaluation data, it may be beneficial for these to be strengthened in view of the expansion of the BEP team and Bloodhound Ambassador network.

6.3 Communication and relationships

The BEP has developed its operating structure considerably over the past year, which has led to improved communication both internally and externally. However, it may be beneficial for the BEP to consider how communication can be further strengthened to facilitate better information sharing and to build lasting relationships with schools and partners.

Internal communication: There have been highly positive developments in the BEP team's internal communications since the previous audit. As a result, some members of the BEP team feel there is now capacity to further develop strategies for communication between the education and engineering teams.

Relationships with schools: In general, teachers viewed their relationships with the BEP very positively. Some report that the BEP could do more to embed school-wide relationships rather than with individual teachers. Teachers feel this would help to promote continuity of engagement with Bloodhound activities across academic years.

At present, teachers do not always feel they have been adequately equipped to follow up activities in schools. It may be valuable for the BEP to provide teachers with a pack of resources, materials or lesson plans after each event.

Relationships with partners: The BEP's engagement with partners has been limited this year. Some partners and businesses have noted that members of the BEP team have a busy and varied workload, and at times this can impact on the quality and regularity of communication.

The BEP is currently developing a customer relation management (CRM) system which aims to promote a more consistent approach to contact with partners and schools. It is envisaged that this will facilitate more regular and consistent contact with partners in the future.

7. Conclusions and recommendations

The findings of this audit provide evidence of the substantial progress made by the BEP throughout 2012 and early 2013.

There are many areas of successful practice throughout the activities of the BEP. Some of their most notable recent achievements include: the systematic development of curriculum linked resources; increased coherence within the Bloodhound Ambassador network and greater levels of support to enable Ambassadors to fulfil their role effectively; and the development of creative ways to engage with the Bloodhound Engineering Project.

The activities and resources delivered by the BEP are highly regarded by all stakeholders, who report a range of positive impacts on pupils, teachers, Bloodhound Ambassadors and businesses alike.

The BEP has an impressive and ambitious vision for the future of the project, and is committed to creating a sustainable education presence after the engineering aspect of the project is complete.



To date, the BEP has been highly successful in building a network of business contacts and, in order to capitalise on progress made, it may be beneficial for the BEP to explore ways of sharing their vision with their educational partners to the same degree.

The BEP may also wish to consider how it can ensure that its activities lead to lasting and sustained outcomes for young people. The development of high quality and ongoing relationships with schools, even when particular teacher contacts move, on is central to this.

The BEP has achieved much success throughout 2012 and early 2013, and there are many positive indications about the project's direction of travel. The BEP can therefore feel confident in pursuing their strategic and operational priorities for the future.



1. Background and introduction

The National Foundation for Educational Research (NFER) has been commissioned by the Bloodhound Education Programme (BEP) to conduct an audit of its activities from early 2012 to the present, building on the findings of two previous audits conducted earlier in the project.

This section provides background information about the Bloodhound Engineering Project and BEP, and sets out the key aims of, and methods used, in the audit.

1.1 The Bloodhound Engineering Project

The aim of the Bloodhound Engineering Project is to design and build a Super Sonic Car (SSC) that will break the world land speed record, which is currently set at 763 mph. The current record is held by the Thrust SSC team, who set the record in Nevada, USA, in October 1997. The same team are involved in the Bloodhound Engineering Project. The car is now in its build phase and in 2015 it will be shipped to South Africa, aiming for a new world record of 1,000 mph/Mach 1.4.

1.2 The Bloodhound Education Programme

The BEP (also called the Bloodhound Education Adventure) was launched in 2008 and uses Bloodhound SSC as an inspiring context with which to attract young people to careers in science, technology, engineering and mathematics (STEM). The BEP works alongside the Bloodhound Engineering Project and offers pupils in primary schools, secondary schools, colleges and higher education the opportunity to engage with information about the development of the car. All of the information about the car is freely available to schools and colleges: this is unique to Bloodhound amongst similar engineering projects.¹ The key activities conducted by the BEP include:

- development and provision of free resources and materials for schools, colleges and universities, often using real-life design challenges and test data
- educational events, roadshows and school visits, delivered by the BEP and supported by a team of Bloodhound Ambassadors
- informal education, for all those interested in learning about Bloodhound SSC (for example, Bloodhound BLAST, a new online learning community developed by the BEP)

¹ Bloodhound is able to provide open data because the Federation Internationale de l'Automobile (FIA) has only minimal prescription about the characteristics of vehicles attempting the world land speed record (four or more wheels and driver control). This leads to a wide range of challenger vehicles and thus technology is unlikely to transfer to competitors. By contrast, the creators of other high performance vehicles such as Defence Space and Formula 1 are not able to provide comprehensive data due to issues such as intellectual property rights, national security and competitive positioning.



- engagement with both private and public sector partners, who support the BEP's activities.

1.3 Aims and methodology of this audit

NFER completed two separate audits of activities for the BEP at the end of 2009 (NFER, 2009) and in early 2012 (Straw and Dawson, 2012). It was then commissioned in early 2013 to undertake a further audit of activities to explore how the BEP had progressed since the last round of consultations and data collection.

The 2013 audit included telephone consultations with the following consultees:

- 11 BEP staff
- eight partner organisations and businesses working with the BEP
- eight Bloodhound Ambassadors
- representatives from ten schools/colleges which have been involved in the BEP's educational activities.

The report also draws on relevant monitoring and internal evaluation data related to, for example, registrations on the website, usage of resources housed on the website and attendance at events. In addition, the audit team attended two education events in North Lincolnshire and Kent at which they consulted with pupils and teachers.



2. Management, staffing and funding

This section presents information about the current management, staffing and funding arrangements for the BEP, including key developments since the previous audit.

2.1 Management and staffing

The BEP continues to be managed and delivered by a core team of staff supported by a wide network of Bloodhound Ambassadors, who volunteer to promote Bloodhound at events and run practical sessions at schools and colleges. The size and structure of the core team has grown considerably since the previous audit. An overview of the BEP team is provided in Table 2.1.

Table 2.1 Overview of the BEP team

Role	Description
Education Strategy Director	Responsible for leading the overall strategic direction of the BEP.
Education Director	Responsible for overseeing the BEP education offer from Key Stage 1 through to further and higher education.
Delivery Director	Responsible for direct delivery into schools, communications and monitoring.
Bloodhound Ambassador Programme Manager	Responsible for liaising with and recruiting Ambassadors, and supporting schools in working with Ambassadors.
Bloodhound BLAST Project Manager	Responsible for informal and social learning and development of the Bloodhound BLAST site.
Trainers/animators	Responsible for training Bloodhound Ambassadors and supporting the other members of the Bloodhound education team at events.
Resource developers	Responsible for devising educational materials and advising schools on their use.
Bloodhound@University	Responsible for developing the BEP's university offer.
Web manager	Supports the BEP by updating the website and monitoring web activity.

In light of the expansion of the BEP, senior staff have taken steps to increase the effectiveness of the way that the team operates. This includes, for example, reviewing the frequency and format of team meetings and holding individual meetings with staff to explore how practice can be improved. This is considered to have improved communication within the BEP team and led to a more collegiate working environment.



The BEP has also sought to develop closer working relationships with other teams within the Bloodhound Engineering Project. For example, this has included building closer links with the Bloodhound public relations (PR) team which has led to the creation of a PR plan for the work of the education team and activities related to the stage of the car's development. This has been beneficial to the BEP in promoting and supporting their activities (for example, through the production of promotional videos and blogs).

2.2 Funding

The BEP received start-up funding of £615,000 in from the Department for Children, Schools and Families (DCSF), now the Department for Education (DfE), for the first 18 months of the project. Further in-kind support, resources and equipment have been provided by both private sponsors and other organisations with similar educational aims to Bloodhound. Since 2010, all of the BEP's outreach work has been self-funding, delivered through income derived from its events and roadshows. In 2012, the BEP was allocated £120,000 of a grant awarded to the Bloodhound Engineering Project by the Engineering and Physical Sciences Research Council (EPSRC). This funding has been used to develop resources throughout all key stages, including higher and further education.

The total expenditure of the education project to date (from April 2007 to June 2013) is £1.48 million.



3. Progress since the 2012 audit

The BEP has developed its education offer substantially over the past year, reflecting a critical period in the development of the Bloodhound SSC. This section describes the key areas of progress made since the previous audit in early 2012.

3.1 Overview of progress since early 2012

The Bloodhound SSC has been subject to increasing interest over the past year as it comes closer to completion and the attempt to break the land speed record. This has had a considerable effect on demand for educational activities offered by the BEP. As a result, the BEP has had to prioritise its activities in order to manage its time and resources effectively. The BEP has focused its energies primarily on those activities likely to lead to a lasting, sustainable impact. For example, new developments since the previous audit include:

- the development of Bloodhound BLAST, an interactive, online community for Bloodhound Ambassadors, engineers and learners of all ages
- commissioning external organisations (for example, the National STEM Centre and Petroc) to produce a new suite of curriculum focused resources for schools
- sharing knowledge and expertise amongst the Bloodhound Ambassador network through a series of Bloodhound Ambassador conferences.

3.2 Bloodhound Ambassadors

A total of 525 Bloodhound Ambassadors currently volunteer with the BEP. Of these, 243 (46 per cent) are independent Ambassadors (individuals who have made a personal commitment to the BEP) and 282 (54 per cent) are Ambassadors from businesses which have made a corporate commitment to the BEP. This represents a modest increase of around 50 Ambassadors since the previous audit in 2012 and it is anticipated that this number will increase through the further development of the BEP's corporate Ambassador programmes. For example, 25 members of the Royal Electrical and Mechanical Engineers (REME) have recently undertaken training with a view to becoming Bloodhound Ambassadors and cascading their learning to other members.

Table 3.1 provides details of the number of Ambassadors signed up to the programme, including those from businesses which have made a corporate commitment to the BEP.



Table 3.1 Number of Bloodhound Ambassadors within businesses with a corporate commitment to the BEP

	Number of Bloodhound Ambassadors
Independent	243
Businesses:	
Aish Technologies	4
Arco	45
Cisco	42
GE Energy	21
IMechE	59
Intel	20
Promethean	7
REME	25
Rolls Royce	59
Total	525

Source: BEP, June 2013.

In addition to Bloodhound Ambassadors, there is also a Bloodhound SSC supporters club, known as the '1K Club'. There are currently 5,815 1K Club members.

3.2.1 Training and professional development for Bloodhound Ambassadors

Introductory training is offered free of charge to all independent Bloodhound Ambassadors and is included within the BEP's corporate package for Ambassadors from businesses. Ambassadors are also registered with STEMNET's STEM Ambassadors Programme and can access training offered by STEMNET.

Over the past year, the BEP has sought to build a strong knowledge exchange and professional development network for Ambassadors, and this has included the appointment of a dedicated Bloodhound Ambassador Programme Manager. The BEP has increased the availability of regional training for Ambassadors and this will be extended through the BEP's programme of Ambassador conferences. To date, the BEP has held two Bloodhound Ambassador conferences (in January and June 2013). It is intended that these conferences will be held regularly at various locations throughout the UK and enable Ambassadors to access expertise from within their own local network. The conferences also enable the BEP to reinforce important messages and keep Ambassadors informed of developments in the project. This is further supported through the production of a monthly newsletter for Ambassadors.

3.3 School visits, roadshows and events

The BEP and Bloodhound Ambassadors supported or led 133 separate educational events in the UK throughout 2012, representing a total of 284 days spent at events. The BEP estimate that an average of 200 pupils attend per day. This suggests that 56,800 pupils were

involved in Bloodhound educational activities in 2012. This includes large national events (for example, The Big Bang Fair and the Festival of Speed), regional and locally organised educational events and school visits.

The BEP takes a demand-led approach to its educational offer and does not have specific targets for school visits. Indeed, it is difficult for the BEP to monitor the number of school visits undertaken as many are conducted by Ambassadors working with the BEP's corporate partners (who do not themselves always know how many visits their staff are undertaking); individual Ambassadors (who do not always inform the BEP when they are undertaking visits) and Ambassadors who use Bloodhound activities as part of STEMNET's STEM Ambassadors programme. However, Ambassadors are expected to generate more sustained relationships with local schools with a view to promoting quality, rather than quantity, of engagement.

Over the past year, **the BEP has embedded its schools workshops programme**, which aims to engage with both local authorities and schools as part of a county-wide offer² (drawing on the support of local sponsors). In this model the BEP team rotates between a number of schools or colleges and delivers workshops to groups of schools and young people who travel to the venue. To date, county-wide events have been held in Enfield, Kent, Norfolk, Northampton, Nottinghamshire and Somerset. Discussions are currently underway to deliver events in a further six counties.

The BEP is also considering offering **support to after school clubs** and encouraging Ambassadors to work more closely with schools through working with their club. This is a new development for the BEP and the team aims to devise a six-week programme that can be delivered by Ambassadors in a series of one hour sessions

3.4 Online engagement

The BEP has made considerable progress in developing its online offer for teachers, pupils and schools over the past year. In addition to building the number of Bloodhound registrations via the website, the BEP has developed Bloodhound BLAST, an online learning community for learners of all ages. The BEP has continued to increase its social media presence, including Facebook, Twitter and YouTube.

3.4.1 Bloodhound BLAST

Since the previous audit, the BEP has introduced **Bloodhound BLAST**, a free, interactive learning environment relating to the Bloodhound project. The site was launched at the Big Bang Fair in March 2013 and includes project data, videos, images and resources aimed at learners of all ages, although primarily young people (5-19 years). In addition to viewing and downloading data from Bloodhound BLAST, users are also encouraged to join communities of common interest and to contribute new materials of their own. The site is intended to have global reach, including schools, engineers and Ambassadors from all over the world. Details of Bloodhound BLAST usage up to the end of June 2013 is provided in Table 3.2.

² This is an expansion of the FE offer described in the previous audit report.



Table 3.2 Usage of Bloodhound BLAST, March – June 2013

	Users	Number of items 'liked'	Number of comments made	Number of videos uploaded	Number of other items uploaded
Bloodhound Ambassadors	188	162	518	83	351
Teachers (teaching ages 0-11 years)	70	40	81	22	59
Teachers (teaching ages 12-16 years)	46	26	44	14	57
Teachers (teaching ages 16+)	17	40	75	22	57

Bloodhound BLAST represents an important step forward in establishing the conditions for sustainability after the Bloodhound Engineering Project comes to an end. Bloodhound BLAST has received £300,000 in sponsorship by Dendrite Learning Partnership, the company who hosts the site, and the BEP is proactively seeking corporate sponsorship to facilitate its ongoing development. It is intended that Bloodhound BLAST will become the primary online learning environment for the Bloodhound project, with the existing website used to provide technical information about the development of Bloodhound SSC. The site will also link to Bloodhound's external partners and content on other STEM education sites (for example, this may include resources available from STEMNET, IMechE, and the Institution of Engineering and Technology (IET)) with a view to becoming a 'one-stop-shop' for STEM activities.

3.4.2 Web registrations

Staff and individuals from schools, colleges and other organisations with an educational remit are invited to register their interest in Bloodhound after which they can access the teaching resources and receive regular email updates. To date, a total of 5,453 educational institutions have registered with Bloodhound. Of these, 1,550 (28 per cent) have registered directly through the website and the remainder through Bloodhound's partner programmes and events. Most commonly, registrations have come from the K'Nex Young Engineers Challenge; the Design, Technology and Engineering Education Fair (DTEE); the Big Bang Fair; and events run by the Association of Colleges. Of the educational institutions registered with the programme:

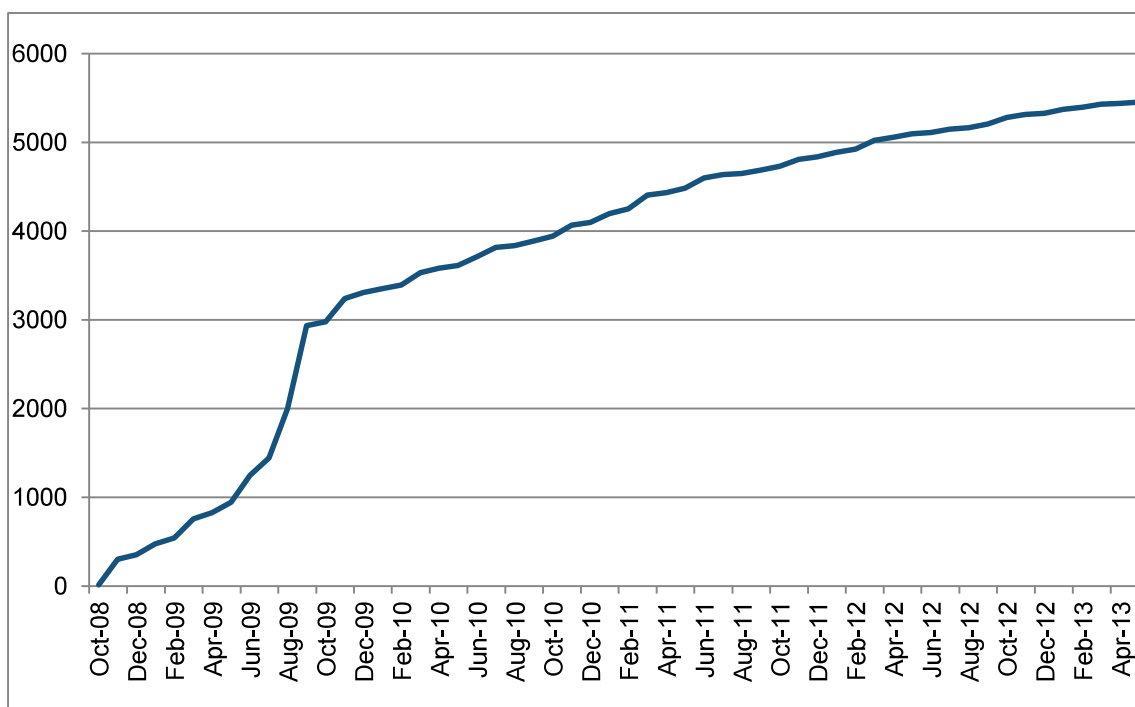
- five are nursery schools (<1%)
- 2,806 are primary schools (51%)
- 2,312 are secondary schools (42%)
- 270 are FE colleges (5%)
- 50 are universities (1%).

While the overall number of registrations has increased since the previous audit (from 4,877 to 5,453), the characteristics of registrants remain similar. Primary schools continue to make up more than half of all registrations, and registrations come from institutions located in all



regions of the UK as well as the Channel Islands. The vast majority of schools registered have a mixed intake with a small, and similar number, of boys and girls-only schools. Ninety per cent of the schools registered are state schools with 10 per cent being independent. As shown in Figure 3.1, registrations have continued to increase throughout the life of the Bloodhound project.

Figure 3.1 Cumulative number of registrations with Bloodhound (Source: BEP, June 2013)



3.5 Resources

Over the past year, the BEP has taken an increasingly **systematic approach to developing resources**, using both internally produced and externally commissioned materials and providing a common format. The BEP aims to ensure that all resources link closely to the curriculum, with educational outcomes a key priority.

3.5.1 Current resources for schools

To date, the BEP's internal resource development team has produced almost 40 unique resources from Key Stage 1 to Key Stage 5, all of which are hosted on Bloodhound BLAST, and many are available to download from the TES website, the National STEM Centre eLibrary and STEMNET's website. For example, these resources include creating 'chatterboxes' (an origami paper craft, with information about Bloodhound SSC in each section), and resources covering topics such as speed, motion (for example, the motion of wheels), resistance and resistant materials. All resources are designed to be inexpensive and straightforward to deliver in the classroom. While it can sometimes be challenging to obtain detailed feedback from schools, the BEP is active in consulting with teachers about their needs and aims to produce resources which meet the requirements of schools and colleges.



The resource development team also advises schools on the most effective use of Bloodhound resources, and tests and evaluates products relevant to the Bloodhound Engineering Project (for example, DynaKar) to assess whether they can be used within a Bloodhound context. Sometimes, the BEP adapt materials to make them more Bloodhound appropriate (for example, creating sleeves for the DynaKar so that they look like Bloodhound SSC).

In the future, the BEP would like to place more emphasis on ICT in response to changes in the ICT curriculum (the BEP already offers resources on programming, the use of Scratch, a basic programming used in schools and has developed an augmented reality 'app' to enable young people to interact with a visual representation of the car); as well as on the biological sciences (for example, the driver's diet and physiology) to provide for a different audience and young people with different motivations. The BEP also hopes to use the car as a jumping off point into other areas of STEM (for example, ceramic plates, which are also used in hair straighteners, and the chemicals used to fuel the car's rocket, which are also used in hair dye).

3.5.2 Bloodhound@University resources

The University of the West of England (UWE), in collaboration with the University of Southampton, continues to develop Bloodhound@University. This brings together academics from 12 universities to use information from the Bloodhound project – car design, test results and overall project delivery - to collectively create and disseminate materials using a drop box (also known as Knowledge Box or 'K Box') to support the teaching of university academics in the group and across the UK.

Bloodhound@University currently has 70 academic subscribers and 150-200 resources. To date, there have been 6,500 downloads, although analysis has not yet been undertaken to understand which universities/regions are making the greatest use of resources. Over the past year, Bloodhound@University has run a series of meetings with academics to introduce them to the K Box as well holding a small number of networking meetings to enable the academic community to interact directly with Bloodhound engineers.

Bloodhound@University has been allocated a proportion of the funding awarded to the Bloodhound Engineering Project by EPSRC and is using this to fund software development of the K Box and to offer seedcorn funding (£5,000 per project) to academics to add content and interact with the data. The aim of this is to increase usage, functionality and impact of the resources.

3.5.3 Externally commissioned resources

In addition to those produced in-house, the BEP has commissioned a number of external organisations (for example, the National STEM Centre and Petroc) to produce high quality STEM teaching resources for use across all key stages. The National STEM Centre has now produced a package of resources for Key Stage 5. These resources are curriculum-linked and include the following topics: statistics (applicable to the mathematics curriculum); circular motion and materials (applicable to the physics curriculum); and mechanics (applicable to both the mathematics and physics curricula). The resources have been produced as an ongoing scheme of work, using Bloodhound as a context (for example, selecting materials for Andy Green's fire resistant suit). The lessons emphasise practical,

investigative approaches as well as careers-related learning. The Key Stage 5 work package will be ready for use in schools in September 2013.

The National STEM Centre has also commenced work on a series of careers themed lessons for Key Stage 2 and 3 pupils. The resources will teach pupils about the variety of careers available relating to STEM and will showcase a variety of pathways to STEM careers.

3.6 Work with partners

Partnerships continue to be an important element of the BEP's operations and activities, although progress in this area has been limited this year as the BEP has instead focused on meeting demand in schools and improving the development of resources. The BEP team report that it is challenging to resource effective engagement with a range of partners and have identified this as a key priority for future development.

Nonetheless, the BEP has maintained its links with a range of private sector partners (which support Bloodhound with time, resources and materials or are involved to the Bloodhound Ambassador programme) and educational partners with similar or complementary aims to the BEP.

Examples of the BEP's private sector partners include: Arco, Cisco, GE Energy, IMechE, Intel, Promethean and Rolls Royce. New partners this year include Aish Technologies and REME. The BEP's educational partners include: STEMNET, Engineering Explained, F1 in Schools, Engineering Development Trust; Silverstone Study Centre; LSIS, Primary Engineer; STEPS at Work; Smallpeice Trust; Careers Box and Future Morph.



4. What is working well?

Since the previous audit, the BEP has expanded considerably and this has enabled the team to make substantial progress in several key areas (see section 3 for further details). This section explores a number of these areas, which have been highlighted by BEP team members, Bloodhound Ambassadors, partners and schools as being particularly successful or representing good practice. Specifically, the section explores:

- creativity and innovation, including the development of new strategies to engage with Bloodhound's key audiences
- systematic development and use of resources, including those with greater curriculum links and emphasis on educational outcomes
- engagement with, and work of Ambassadors, including the development of a lively Ambassador community and network of support.

4.1 Creativity and innovation

The BEP continues to **develop creative and innovative ways to promote their learning materials and increase the engagement of schools**. Most notably, they have made significant developments in finding ways to increase the availability and use of Bloodhound resources and to bring communities of interest together. This includes Bloodhound BLAST, a new online facility which links schools, Bloodhound Ambassadors and engineers interested in following the progress of Bloodhound SSC (see section 3 for further details). While in its early stages, **Bloodhound BLAST** is considered to have tremendous potential to further enliven young people's experiences of learning about Bloodhound SSC and increase access to a range of new, interactive resources. Accessible to young people, schools, Ambassadors and businesses alike, it is anticipated that Bloodhound BLAST will become an increasingly valuable resource in promoting engagement with the BEP as further materials become available and membership of the community increases.

The **Bloodhound@University K Box** is another example of an innovative strategy used by the BEP to derive value from the Bloodhound activities. As a facility for sharing data from the Bloodhound Engineering Project within the academic community, the K Box is unique in providing access to freely available, raw data. The network of universities who use the K Box has proven to be a highly valuable resource for Bloodhound, **strengthening the quality of the engineering and education components of the programme and leading to real-life solutions in the design and build of the car**. For example, a group of MEng students were asked to explore the ergonomics of the car's steering wheel using raw data downloaded from the K Box. As a result, 25 design solutions were proposed and shared with the engineering team and some of the features have been included in the final steering wheel. Additionally, data made available through the K Box has enabled academics and the Bloodhound engineering team to participate in a joint design review to discuss calculations relating to the design of the car. This has led, for example, to the tail fin of the car increasing in size.

4.2 Systematic development and use of resources

In response to feedback received in previous audits, the BEP has invested considerable time and resources into the development of materials for schools (see section 3 for further details). The development of resources is now more systematic and recent resources contain a greater number of curriculum links. Resources are also more consistently formatted to further ease of use by teachers. This is considered to have been highly beneficial in promoting schools' ongoing engagement with the Bloodhound Engineering Project.

We have taken a more systematic approach to developing resources. We are creating more and refreshing the existing website. We are making them more usable and giving them a common format with curriculum links and education outputs at the forefront. We are looking at the gaps and what the audience wants from us and being more strategic.

(BEP team member)

Feedback from teachers suggest that the BEP's materials for schools are of high quality, and some schools have been able to provide examples of ways in which these resources have been successfully embedded into the curriculum. For example, one school reports that it has based all of its learning in the past academic year around the theme of the land speed record, and has systematically incorporated Bloodhound into its programme of activities. This has included: use of resources from the Bloodhound website (for example, the school used materials about chassis and axle design to support pupils in building a prototype car and subsequently a life-size 'buggy') and sessions with a Bloodhound Ambassador. The school has had an extremely positive experience of working with Bloodhound this year, with teachers reporting that the activities have been effective in supporting curricular activity, easily adapted to meet the needs of the schools, and valuable in promoting the engagement of pupils and increasing their knowledge and skills (both engineering-related and more transferable skills).

Teachers also report positive feedback about the resources and materials delivered at BEP events and workshops. In particular, they value the lively and engaging presentations that the BEP team and Bloodhound Ambassadors deliver in their schools.

[... the presentations contain] the right amount of material to grab the kids ... [the Bloodhound Ambassador] did an outstanding job with the assembly.

(Teacher)

Feedback from teachers attending roadshow events in Nottingham in 2012³ shows that they feel the practical aspects of the events are particularly effective (for example, over 70 per cent feel that opportunities for pupil participation are excellent, and over 70 per cent feel the facilitation of activities is of excellent quality).

4.3 Engagement with, and work of, Ambassadors

The commitment, enthusiasm and calibre of the BEP's network of Bloodhound Ambassadors continues to be a key strength of the project. Over the past year, the BEP has effectively

³ Feedback provided by 119 teachers attending the Nottinghamshire roadshow events in 2012.



engaged with a growing network of Ambassadors who are passionate about their involvement in Bloodhound SSC.

To roll out Bloodhound to every school would be the best thing and we can only do that through the priceless resource that is Ambassadors ... it is really nice to see that there are people out there who want to go out and see the educational benefits for the future of the country.

(BEP team member)

Flexibility in the ways that Ambassadors can engage with the BEP is critical to its success. Ambassadors report that opportunities to engage are available to suit individuals in a range of different circumstances, from many professional backgrounds, and with differing amounts of time available to contribute to the project:

There is a role in Bloodhound for lots of different people ... there are loads of different roles. There is something that you can do that is useful whether you are part of a big organisation or you run your own business or your part of an organisation that isn't involved in Bloodhound yet, there are loads of things you can do and I think that's what's great.

(Bloodhound Ambassador)

In the previous audit, a need was identified to increase the levels of support for Ambassadors when they join the BEP. The BEP has put in place a number of improvements in this area, which have been positively received by both individual Ambassadors and the BEP's corporate partners. For instance, this has included: two Ambassador conferences (see Figure 4.1 for further details); a monthly newsletter; and the appointment of a dedicated Bloodhound Ambassador Programme Manager responsible for liaising and recruiting Ambassadors, and supporting them in their interactions with schools. Ambassadors are also now being offered more 'buddying up' support by experienced Ambassadors and members of the BEP team who have previously volunteered with the BEP. Feedback received from Ambassadors suggests that these changes have been very positive:

I was feeling a little isolated ... but now the whole project feels a lot more inclusive.

(Bloodhound Ambassador)

It is also good to know that one of the education team is at the end of a phone if I ever need them for advice.

(Bloodhound Ambassador)

In coming months, the **BEP will meet with coordinators of all of the company based Ambassador schemes**, to explore ways in which the BEP can support them more effectively (in some instances, this is already happening: for example, IMechE members are brought together as a group and offered tailored support).

Figure 4.1 Example of good practice, Bloodhound Ambassador Conferences

To date, the BEP has delivered two conferences for Bloodhound Ambassadors (in January and June 2013). These conferences met a recognised need to provide further support to Ambassadors, who have previously reported that they would welcome greater support and preparation, particularly relating to: presentation skills and activities so that they can present to a wide range of young people; more current information about the wider Bloodhound project; and the technical aspects of the car's development.⁴

All of these aspects were covered during the Ambassador conferences and feedback from the January conference indicates that the event was highly successful, with over 75 Ambassadors attending. As a BEP team member comments:

The conference is one of the best things we have done since I have been on board as it gave Ambassadors a chance to meet with the team and to meet each other ... they could talk to each other and share best practice.

(BEP team member)

Ambassadors themselves note that they found the conference beneficial in a number of ways, including the opportunity to:

- network with colleagues and to learn from the best practice of others
- learn about new developments in the project and speak directly with engineers
- hear about new educational resources and effective ways to interact with schools
- become familiar with Bloodhound BLAST, in particular how to upload and share information with other Ambassadors
- become more closely acquainted with the BEP team and feel part of a wider community.

As one Ambassador comments:

I've met a lot of people and made a lot of contacts and I've learnt a lot from other people doing things.

(Bloodhound Ambassador)

The BEP is planning further conferences in the future, each based in different regions of the UK to maximise the number of Ambassadors' able to attend.

⁴ Feedback taken from evaluation data gathered by the BEP at the Nottingham roadshows in 2012.



5. Outcomes to date

A variety of outcomes have been realised for a range of beneficiaries of the BEP (i.e. young people, teachers, Bloodhound Ambassadors, and businesses). As in previous audits, these include such outcomes as: young people's increased awareness of the importance of engineering and STEM, and their enhanced enthusiasm for engineering now and in possible future careers; teachers' enhanced knowledge in relation to STEM subjects; Ambassadors' new skills for working with children and young people; and businesses' increased commitment to engaging young people in STEM and engineering. This current audit continues to draw out these outcomes, and in addition highlights the strength and level of sustainability of these outcomes.

5.1 Outcomes for young people

Data gathered on outcomes for young people reinforces the findings of previous audits, but this year interviewees particularly highlight outcomes such as sparking young people's enthusiasm for engineering, and the importance of applying their new learning in interesting ways in order to ultimately inspire young people into taking up engineering related careers⁵.

5.1.1 Enthusing and inspiring young people about engineering (and STEM)

Young people's **enhanced enthusiasm for, and interest in, the Bloodhound project and engineering** (and STEM more widely) is evident amongst all the feedback gathered. At its most immediate, young people gain **a sense of 'fun'** from the Bloodhound activities they take part in, as well as **for some, deeper inspiration and interest** in relation to engineering:

I get children coming up to me and saying "I never used to like science before, but I didn't realise it was fun like that".

(Bloodhound Ambassador)

It is a really rich project, to really inspire their learning. It was just incredible and so engaging ... it has been truly inspirational work that we have been able to do as a result of our links with Bloodhound.

(Teacher)

In feedback provided by young people attending a roadshow event in Nottingham in 2012 (depicted visually in the word cloud show in Figure 5.1, with the size of each word representing the frequency with which it was reported), young people themselves described the Bloodhound activities as 'amazing, fun, interesting, exciting, mind-blowing, awesome,

⁵ Outcomes for young people have been categorised into four areas, in an order starting with those closest to the young person themselves now (for example, sense of fun, enthusiasm) and moving to those further away (for example, other learning, and effect on future career possibilities).

educational ...⁶. The feedback also showed that 81 per cent of young people⁷ completing the forms felt the event had made them more interested in science. In addition, feedback from 119 teachers attending these events showed that these teachers all rated pupil enjoyment from the events as excellent or very good⁸.



5.1.2 Increasing young people's understanding, knowledge and skills in relation to engineering and STEM

We once asked what the pupils had learned after a presentation. We had one guy aged 11 who said, "I have learnt that as engineers, we don't always get it right first time but we keep trying until we do". I thought, there is a lot of impact there.

New learning specifically relating to engineering and STEM is an area of impact for young people, noted mainly by their teachers as well as BEP staff (more so than by

Ambassadors and partners). Young people gain specific knowledge, understanding and skills in engineering and STEM. **Practical activities are important** in realising these impacts. **Applying their learning** 'in a fun way' and relating it to 'real life' is also important to enhancing young people's understanding:

We have a way of presenting algorithms to anyone from a young age that get more complex as you get older. Young people can see what happens with the mathematics visually, which aids understanding. We want them to think that maths is fantastic and to allow them to interact with the data and see what it means.

(BEP team member)

The reason for bringing in Bloodhound was to cover forces. We were doing it over 3 weeks and I thought it would be fun to bring the topic alive and reinforce the pupils' forces knowledge. My year 4 class joined up with the year 3 class who didn't know anything already. My class could share their knowledge which was fantastic. It was learning for the younger ones and it reinforced learning for the older ones.

(Teacher)

In feedback from the Nottinghamshire roadshow events, 88 per cent of young people⁹ completing the forms indicated that they had learned 'lots' from the event. As well as many references to now knowing the land speed record, and that Bloodhound is trying to get to a record of 1050mph, things young people had learned included: 'how speed works', 'about the environment', 'how rockets and fuel are used in engines', 'that the car will be faster than a bullet', 'that hair dye and rubber is in the engine', 'about forces', 'that the engine gets put in the middle, because if it's at the front it will tilt forward', 'that it wasn't the rocket that powered it along, it was the air pressure' and 'it uses one tonne of rocket fuel in 19 seconds'.

Young people's new knowledge and skills **could be further built upon and sustained** through greater linking with other activities such as the CREST Awards, through the library service (one teacher suggested through the library service reading challenge), and by involving parents more ('longer term impact depends on activities going home' (Teacher)). (Section 5.2 provides a case study example of how a group of schools has built on the Bloodhound project in both curricular and extra-curricular ways, thus impacting further on the young people and their teachers.)

Examples of impacts on young people are visible in the findings of two case studies: one at an educational event for schools held in North Lincolnshire, and another at a roadshow held in Kent. An overview of the impacts arising from these events are presented in Figures 5.2 and 5.3 overleaf.

⁹ Responses here also include the 15 respondents aged 16 or over (for example, parents/teaching assistants).

Figure 5.2 Impacts arising from an educational event in North Lincolnshire

In February 2012, the BEP delivered a one-day educational event in North Lincolnshire. The event was hosted by Tata Steel, who invited local primary schools to attend. The BEP team ran two half-day sessions, catering for a total of 70 pupils from seven schools. Each session consisted of a presentation about Bloodhound SSC, a practical activity and an engineering planning task. The sessions were led by a member of the BEP team and supported by Bloodhound Ambassadors.

Pupils reported that they experienced a range of impacts as a result of attending the event. The bullet points below give an overview of these impacts and some examples of comments made by pupils.

- **Greater understanding and appreciation of what it means to be an engineer**

It's not what I expected engineering to be like. It's better, more practical.

I thought being an engineer would be quite boring, but now I see that it's quite fun.

I learned something new about what engineering can be.

- **Improved knowledge of STEM topics relating to Bloodhound SSC**

It is a fun way to learn about all about forces.

[... I learned about thrust because] the balloon car goes faster with a smaller balloon.

- **Improved team working skills and attitudes to learning**

I have learned that it's ok to make mistakes.

[... we chose a team leader] who is the best at engineering.

In their evaluation forms at the end of the event, pupils were asked to select key words to describe their experiences. These words included: fantastic, different, fun, amazing, interesting, exciting and nerve-wracking. Pupils anticipated that they would continue to discuss Bloodhound SSC with their peers after the event.

Teachers were also highly positive about the event, and felt that the context of Bloodhound SSC was beneficial in providing pupils with a current, real-life example of cutting edge technology. Teachers were therefore enthusiastic about building on pupils' experiences in lessons.

It's great because it's current ... it's not like [a piece of] history, it's happening now. It could go right, it could go wrong.

(Teacher)

This was a very informative but fun morning – this has inspired me, as well as given me the chance to learn more about Bloodhound. We will definitely register [with Bloodhound] and follow the event up in school.

(Teacher)



Figure 5.3 Impacts arising from a roadshow in Kent

In March 2013, the BEP held a three-day, county-wide educational event for schools in Kent. The educational component of the event was delivered to over 200 pupils from secondary schools in the local area and ran alongside a series of sessions for local businesses, teachers and members of the general public.

Pupils participated in four key activities: a presentation, a practical activity, an engineering planning task, and a 'show and tell' using a full-size replica of the Bloodhound car. Pupils appeared to respond particularly well to the engineering planning task, engaging in comprehensive discussion and developing innovative solutions to the problems posed (for example, considering transport, health and weather considerations for the Bloodhound engineering team and the car when preparing to test it in the Hakskeen Pan). Bloodhound Ambassadors noted the wider benefits of this in improving pupils' social skills: pupils were divided into mixed school groups, and many overcame their initial reservations to work effectively with those from other schools.

Pupils themselves reported that they enjoyed the day and that it had enabled them to gain a better understanding of real-life applications of engineering. Teachers considered this to be beneficial for all pupils, especially those specialising in engineering-related topics (for example, GCSE Resistant Materials). They also reported that the outcomes were likely to be particularly significant for pupils in Year 9, who were selecting their Key Stage 4 subjects.

Feedback from teachers collected by the local organisers of the event, Bloodhound Swale¹⁰, demonstrates the positive ways in which the learning from the event has been transferred back into school:

Yesterday the children fed back to the rest of the school during a special assembly about the Bloodhound experience. They were full of facts and information about the car and the rest of the school were really keen to learn about it. It was a really valuable experience and certainly tapped into the interests of the children.

I have often seen our children enthused after a school visit, but I was really impressed with the amount of detailed information they had taken in and the enthusiastic way in which they explained to the rest of the school all the challenges facing both the engineers and the driver as they develop the supersonic car.

I did a feedback form with the students – the response was: Bloodhound SSC is cool and it made them think about STEM when considering their GCSE options and possible career options.

5.1.3 Other new learning and skills development

As well as engineering-specific learning, young people also develop skills in other areas, particularly in **team work**, **problem solving**, **self-confidence** and **communication skills** (for example, in one school, pupils developed their communication skills by negotiating with a timber yard about the materials for their project):

¹⁰ <http://www.bloodhoundswale.co.uk>

It has given the young people a lot of confidence to do activities they wouldn't normally do, and to be successful when they don't expect it.

(Bloodhound Ambassador)

It was impressive to see the little eight and nine year olds ... they were so focused and they got on with it and they got the concept of working in a team and helping each other, dividing up tasks and working collaboratively.

(Bloodhound Ambassador)

For some schools the BEP provides an excellent opportunity to work in a cluster with other schools and, as a result, to **improve transitions** between primary and secondary school for their young people. In one example where schools worked in a cluster on the Bloodhound project, we were also told about reduced rural isolation for pupils.

5.1.4 Raising awareness of, and interest in, engineering jobs and careers

As previously reported, the Bloodhound education team and Ambassadors bring the **careers dimension** into events and school/college visits wherever possible, to raise young people's awareness of the jobs and careers open to them in engineering and the pathways to get there. Challenging gender stereotypes is an overt part of their work. **Inspiring young people to think about engineering careers** is felt, particularly by teachers and business representatives, to be a vital part of the Bloodhound project:

Bloodhound is a good way of signposting young people into other engineering projects [and] linking things together.

(Bloodhound Ambassador)

As far as we are concerned Bloodhound is a vehicle to really push STEM careers and to get children inspired in science, technology, engineering and maths, and we find it really successful.

(Teacher)

The most important thing was raising their awareness [of engineering careers] and enthusing them. Science can be abstract, so it was good to have someone in the classroom talking about what they can do.

(Teacher)

If you can see 10 or 15 young people change and want to do this [become an engineer] then I think we have made a difference.

(Partner)

In terms of targeting the careers dimension of the programme, some teachers feel that Ambassador talks about careers with engineering are most helpful for Key Stage 4 pupils. However, **for sustainability**, many feel that **'starting young'** is important:

I think if you want them to be engineers, you have got to start [working with] them young [i.e. at primary school]. The younger ones are more willing to listen, they don't have to prove themselves, and they are more open.

(Bloodhound Ambassador)



5.2 Outcomes for teachers

Whilst the main aim of the Bloodhound's activities is to engage and inspire young people, outcomes for teachers are also evident although more limited. Outcomes include **new and wider subject knowledge** (for example, understanding additive manufacturing as used in trainer rubber) and teachers gaining **tips for STEM activities** they can run themselves (for example, a wacky races project in school).

Several teachers told us how they very much welcomed the input from Bloodhound Ambassadors and have been inspired to **organise more talks from/sessions with Ambassadors** for their young people (for example, as part of school science weeks, through STEMNET, etc).

Where **schools are working in clusters** on the Bloodhound challenge, impacts include **greater school-school collaboration**, new projects being introduced into other schools, and **the development of work for specific groups of young people** (for example, gifted and talented, transition work, Year 6 competitions, etc) (an example of this is provided in Figure 5.4).

Examples of more embedded work, including new ways of integrating engineering/STEM into the curriculum are limited. **Focusing greater attention on impacts for teachers and schools** would be beneficial to the longer term impact on pupils' learning and interests.

Figure 5.4 An example of how a cluster of schools have worked together to develop curricular and extra-curricular engineering activities

Integrating Bloodhound activities into school curricular and extra-curricular work

School A, a primary school in a rural county, takes part in annual science and engineering weeks, and regularly welcomes STEM professionals as well as others (for example, artists) into their school to inspire children about a range of careers.

A few years ago, the school hosted a Bloodhound activity day led by the BEP team. All classes from Foundation up to Year 6 were involved, making a variety of cars (K'Nex, balloon powered, etc), and racing them in the hall like a 'Top Gear' challenge. Parents participated at the end of the day, and were able to join in with their children and talk to the Bloodhound team. This 'day' led to the school developing their science and DT schemes of work for Year 6 pupils. This included the pupils making sun powered cars as part of their technology project for the term.

The school is also working within a cluster of schools (14 primary and 2 secondary schools in their local learning community) and in conjunction with their local FE college, to develop exciting engineering activities for all their pupils. This led to inter-school competitions around sun powered cars, and has now developed into work involving the whole cluster of schools including secondary schools.

This year, Ambassadors from the college, all with training from Bloodhound, have provided workshops for each primary school. The work is currently focused on Year 5/6 gifted and talented pupils. The two secondary schools have now developed work around rocket powered cars and are inviting pupils from their feeder primary schools to workshops. The children are designing fins for printing on the equipment, and in the summer term, there will be a competition 'race'. The prize will be a visit to the Bloodhound rocket testing 'which the children are really excited about'.

5.3 Outcomes for Bloodhound Ambassadors

As reported in previous audits, outcomes for Bloodhound Ambassadors include: personal **satisfaction and enjoyment** from the Bloodhound work, and particularly from working with young people; development of **skills and confidence in engaging with young people**, including skills in presenting to large groups; enhancement of their own skills and **knowledge relating to STEM**; and **CV building**.

This year, Ambassadors particularly comment on their **new enjoyment and confidence in working with young people**:

I want to give something back after 44 years working in the engineering industry. I get a big kick out of seeing the children's faces ... when you take the show car they are amazed at the size of it, their reaction is superb. I say to them, "this is what science, technology and engineering is all about, designing that" and I enjoy that.

(Bloodhound Ambassador)

It's been a great way to meet people like other Ambassadors and members of the public and particularly the kids. It has been really rewarding to chat to them and see the look on



their faces. It has built up my confidence as it's a really great activity. I can't recommend it highly enough.

(Bloodhound Ambassador)

In addition, Ambassadors report feeling **a sense of membership of the Bloodhound team**, and feeling **part of a network** (Ambassadors have found the recent Ambassador conference particularly valuable for sharing expertise and resources, see section 4). Furthermore, some report wanting to '**spread the word**' amongst workplace colleagues. One told us that he is planning an Ambassador session at lunchtime to raise interest amongst colleagues and that he is trying to get the Bloodhound scheme on his company's list of Corporate and Social Responsibility approved organisations. Another has been inspired to look for further volunteering opportunities with young people and schools through other 'ambassador' and education projects.

5.4 Outcomes for businesses

Outcomes for businesses continue to include those covered in previous audits.

Increased **corporate commitment to raising young people's/public's interest in STEM and engineering** continues to be reported, as do the **reputational benefits** of working with Bloodhound. For one company we spoke to, this includes meeting criteria for membership of 'chartered status' (for example, one criteria being working with schools).

Representatives continue to report **increased staff satisfaction** amongst staff involved as Bloodhound Ambassadors. Staff are engaged and excited to be involved in the scheme. In addition, staff develop confidence and presentation skills (see section 5.3).

This year, interviewees have particularly told us about **consolidating their links with their local communities, FE colleges and schools** – especially where they have now worked with them over several years on Bloodhound activities. New links with universities and other stakeholders are also being made through Bloodhound activities. One representative told us how they are expanding their education work to include 'product experts' from across their company (i.e. another example of **expanding business opportunities** as found previously).

5.5 Sustainability

Feedback from research participants about the nature of outcomes experienced as a result of involvement with the BEP highlights a number of important issues in relation to promoting the sustainability of impacts for all stakeholders.

Participants report, for example, that the extent to which the overwhelming impacts of enthusiasm and inspiration amongst young people then translate into longer term motivation for, or further engagement in, engineering activities is difficult to ascertain. **Preparing the young people in advance** of Bloodhound activities might be beneficial in terms of encouraging deeper learning; however, **the 'wow' factor** achieved when pupils have no

prior knowledge of Bloodhound is also felt to be important¹¹. Certainly, it is felt that **making greater links with the curriculum and encouraging and supporting further teacher follow-up work** would be helpful to young people's continued learning and interest in engineering: as this is an important current focus of the BEP, this is highly encouraging.

Amongst wider stakeholders (for example, businesses and partners), there is great enthusiasm to maintain links with the BEP and to train more Ambassadors (for example, one is planning a recruitment drive and to re-explain the benefits of volunteering with Bloodhound to staff). Some are **thinking beyond the timescale of the Bloodhound Engineering Project**, including starting to plan for other STEM related activities with schools. One company applying for funding for track and electrics so they can establish their own Formula One activities for secondary schools. The BEP therefore has a tremendous opportunity to maximise the potential benefit of such activities by, for example: fostering relationships with its existing partners and business contacts; identifying and building new partnerships (especially those within the education sector); and where possible promoting the coherence of networks of stakeholders with an interest in the Bloodhound project.

¹¹ In feedback from the Nottinghamshire roadshow events, around one third (31 per cent) of respondents knew nothing about Bloodhound SSC prior to the event; just over half (56 per cent) knew a little, and 12 per cent knew a lot. Extent of prior knowledge does not seem to make a difference to the kinds of other responses given, for example, event was good, learned a lot, feel more interested in engineering, etc.



6. Areas for development

The BEP has made strong progress over the past year and has proactively responded to feedback from the previous audits, demonstrating their capabilities as a learning organisation. For example, this has included the development of new resources and the appointment of a new member of staff to support the activities of Bloodhound Ambassadors.

However, as a continually evolving organisation, there are some areas which may benefit from further development to improve and enhance the BEP's education offer. These areas are explored in this section, and include:

- expansion of the range of activities available to schools
- data monitoring and evaluation
- communication with internal and external stakeholders.

6.1 Expanding the range of activities available to schools

While the activities currently offered by the BEP team (for example, balloon cars) are popular with schools, it may be useful for the BEP to consider **expanding the range of activities offered to encompass new topic areas and themes**. This would be particularly valuable for schools with an interest in engaging repeatedly with Bloodhound activities (in some cases, schools involved in this study reported that their pupils had participated in the balloon cars exercise more than once). This may include the development of a greater number of practical activities for use by Bloodhound Ambassadors, ultimately leading to a menu of activities from which schools can select. Some teachers also reported that they would like the BEP team and Bloodhound Ambassadors to **deliver more ambitious activities in school**, using resources and techniques that schools would not be able to offer by themselves.

I was expecting the Ambassador to do something different ... I could have done the ... [balloon cars] myself. Bloodhound need to come up with ideas for when they are visiting for something that the school cannot provide.

(Teacher)

Teachers also report that they would welcome a **greater range of resources and materials for use in schools**, including those which can be easily matched to the curriculum. The BEP is already progressing well towards this, with new, curriculum-linked activities under development by the National STEM Centre.

Teachers have mixed views about the extent to which the activities offered by the BEP **meet the needs of different age groups**. While some report that activities are targeted appropriately, others report that the activities could be tailored more effectively. For example, one secondary school teacher comments that it would be possible to deliver more advanced activities with their pupils (for example, this might include vacuum forming and making wheels out of neoprene). By contrast, another primary school teacher feels that Bloodhound activities would have been more successful if they had been introduced at a more basic level:

The pupils made a balloon powered car and I would have preferred to know in advance that [the Ambassador] wasn't going to teach them how to make one. [... the Ambassador] presumed they had design and technology skills and didn't model making one which the children needed.

(Teacher)

This suggests that it may be beneficial for the BEP to consider how existing resources can be more easily adapted to suit the needs of different age groups and abilities.

In an open response question on the teacher feedback (collected at the Nottinghamshire roadshow events), teachers said they would like more information on following up the work in the curriculum for example, 'practical, child-centered activities linked to the Bloodhound project', 'ways to integrate it into the classroom ... including the mathematics, design and technology, humanities and history curriculum', 'any follow-up activities to be done in school', 'any further related activities on friction, forces and air resistance', 'and on research and problem solving'; STEM careers, for example, 'about careers in engineering or specific roles in the project'; progress with the BEP more widely for example, 'information on the actual speed trial', 'the children are really enthused, so when the event is about to take place, an email to remind us would be great'; and additional resources for example, 'extra resources online', 'information to put up around the school', 'literature and posters about the construction and science of production'. The breadth of appeal from the project is apparent: some teachers requested more activities specifically for Key Stage 5, others for younger pupils in Years 1-6.

6.2 Data monitoring and evaluation

Members of the BEP team, Bloodhound Ambassadors and partners identify data collection relating to the impacts of Bloodhound activities as a key priority for development. While there are mechanisms currently in place to collect monitoring and evaluation data, it may be beneficial for these to be strengthened in view of the expansion of the BEP team and Bloodhound Ambassador network.

For instance, it may be valuable for the BEP to explore ways of monitoring the number of visits conducted by Ambassadors as their corporate volunteering programmes become more established. At present, this is difficult to achieve due to limitation in businesses' own systems for measuring Ambassador involvement in the BEP and because both individual Ambassadors and those from businesses do not always feed this back to the BEP.

Improved evaluative data would also be of particular benefit to the BEP team in further developing their resources and materials for use in schools. While the BEP currently has a system for collecting pupil and teacher feedback following their events, it may be of use to consider ways in which more detailed, data-rich feedback can be obtained (at present, much of this feedback is anecdotal and in verbal form).

I find that sometimes feedback is slow in coming. This could be better. It's very hard to get feedback from schools.

(BEP team member)

In particular, it may be beneficial for Ambassadors to be encouraged to seek regular feedback from schools and provided with support on how to do this effectively.



6.3 Communication and relationships

The BEP has developed its operating structure considerably over the past year (see section 3 for further details), which has led to improved communication both internally and externally. However, it may be beneficial for the BEP to consider how communication can be further strengthened to facilitate better information sharing and to build lasting relationships with schools and partners.

6.3.1 Internal communication

As discussed in section 3, there have been highly positive developments in the BEP team's internal communications since the previous audit. As a result, some members of the BEP team feel that there is now capacity to further develop strategies for communication between the education and engineering teams. For example, this may include strategies for sharing information in a more timely way and facilitating more open discussion and communication of project developments between the engineering and education teams.

[... engineers] are used to working in very closed environments. So to stop and think “I need to share this because it might be interesting to someone” can be seen as a bit of an overhead. So the big step change is to be able to feed [information] more efficiently [between the engineering and the education teams].

(BEP team member)

6.3.2 Relationships with schools

The BEP team is clear that it aims to build sustained and lasting relationships with schools, and effective communication between schools and the BEP team is considered to be vital in facilitating the necessary conditions for this. While, in general, teachers view their relationships with the BEP team very positively, a small number had experienced delays in communication when arranging activities in school. Others report that the BEP team could do more to embed school-wide relationships rather than with individual teachers. Teachers feel that this would help to promote continuity of engagement with Bloodhound activities across academic years.

It's possible that Bloodhound need to do more work on sustainability. I will be changing year group next year and it will be someone else [responsible for liaising with the BEP team] and the contact could get lost. The enthusiasm tends to stay with the teacher. Bloodhound need to do more to maintain the link [with schools].

(Teacher)

Effective mechanisms for following up Bloodhound activities in schools is central to success in this area and, at present, teachers do not always feel they have been adequately equipped to achieve this. It may be valuable, therefore, for the BEP to routinely provide teachers with a pack of resources, materials or lesson plans after each event. It is probable that this would lead to positive impacts, both in relation to the likelihood of outcomes arising from pupils' participation in Bloodhound activities, as well as the longevity of the BEP's relationships with schools which have engaged in the programme.

6.3.3 Relationships with partners

As noted in section 3, the BEP's engagement with partners has been limited this year. Some partners and businesses have noted that members of the BEP team have a busy and varied workload, and at times this can impact on the quality and regularity of communication. Partners also report that while they are broadly positive about the future direction of the BEP, they would welcome more structured, longer-term planning.

Bloodhound is a positive, reactive organisation ... however, it ... [would benefit from] more structure, more longer term planning. This is missing [at the moment].

(Partner)

Now that they [the BEP team] are a much bigger team things have changed. They have more capacity and they need to use it well rather than the roller coaster of scale across the county ... they are doing a good job and the band wagon has started rolling and they are running to catch up.

(Partner)

The BEP is currently developing a customer relation management (CRM) system which aims to promote a more consistent approach to contact with partners and schools. It is envisaged that this will facilitate more regular and consistent contact with partners in the future.



7. Conclusions and recommendations

The findings of this audit provide evidence of the substantial progress made by the BEP throughout 2012 and early 2013. It is clear that the BEP has responded proactively to the needs of stakeholders and has put in place numerous measures to address areas for development identified in the previous audit. This reinforces their position as a learning, reflective organisation.

While there are **many areas of successful practice throughout the activities of the BEP**, some of their most notable achievements since the previous audit include: the systematic development of curriculum-linked resources; increased coherence within the Bloodhound Ambassador network and greater levels of support to enable Ambassadors to fulfil their role effectively; and the development of creative ways to engage with the Bloodhound Engineering Project through initiatives such as Bloodhound BLAST and the Bloodhound@University K Box. The BEP has also altered its internal structure and working practices to facilitate better communication, both within the team and with colleagues in other areas of the Bloodhound Engineering Programme.

The activities and resources delivered by the BEP are highly regarded by teachers and pupils, who report a range of **positive impacts on pupils**, including: increased enthusiasm about engineering and STEM more broadly; greater awareness of engineering and the importance of STEM subjects; improved knowledge and skills in relation to engineering and STEM; and awareness of, and greater interest in, engineering jobs and careers. There is also evidence of wider learning and skills development, for example, improvements in pupils' team work, problem solving, self-confidence, and communication skills.

Likewise, stakeholders report many positive impacts arising from the BEP's activities on: **teachers** (for example, wider subject knowledge and new ideas for delivering STEM activities); **Bloodhound Ambassadors** (for example, satisfaction and enjoyment, skills and confidence in engaging with young people, and enhancement of their own skills and knowledge); and **businesses** (for example, increased corporate commitment to raising young people's/public's interest in STEM and engineering, reputational benefits and improved links with their local communities, colleges and schools).

The BEP has an impressive and ambitious vision for the future of the project, and is committed to creating a sustainable education presence after the engineering aspect of the project is complete. To date, the BEP has been highly successful in building a network of business contacts and, in order to capitalise on progress made, it may be beneficial for the BEP to explore ways of sharing their vision with their educational partners to the same degree. For example, the BEP may benefit from developing closer links with educational partners who share areas of common interest (for example, EngineeringUK, Primary Engineer and STEMNET), engaging in a greater number of collaborative activities. Equally, it may be valuable to explore how such partners can be used for strategic benefit in relation to the sustainability of the BEP. For instance, this may include exploring ways in which the BEP's resources and activities can be integrated into those of other STEM initiatives and

vice versa (Bloodhound BLAST being an excellent example of how this might work in practice).

The BEP may also wish to consider how it can ensure that its activities lead to lasting and sustained outcomes for young people. The development of high quality and ongoing relationships with schools, even when particular teacher contacts move, on is central to this. The BEP may find it helpful to expand their bank of practical activities for delivery in schools to allow repeated interactions with pupil groups to occur more easily and to provide more inspiration and support to teachers to deliver follow-up activities following the BEP's presence in school. The curriculum linked materials available from September 2013 will help fulfil this aim and Ambassadors could be encouraged to leave a pack of appropriate materials with schools. The materials that are being developed for delivery within Engineering Clubs will also support the BEP to maintain long-term relationships with schools.

The BEP has achieved much success throughout 2012 and early 2013, and there are many positive indications about the project's direction of travel. The BEP can therefore feel confident in pursuing their strategic and operational priorities for the future.



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ISBN: 978-1-908666-64-2